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of the parts into which a given territory is divided. A just and reasonable adjustment of boundaries involves something more than the consideration of square miles of territory, since the intellectual and commercial development, not only of the adjacent nations but of all mankind for perhaps many centuries, is involved therein. It may perhaps be urged in opposition to this imperfectly stated, but, as is intended, broad and fraternal view of international relations, that the greed of nations for territory renders the services of the geographer unnecessary to the framers of treaties, except so far as they remove grounds for dispute—and perhaps not even then, since an aggressive nation may design to involve its neighbours in fresh controversies. Admitting that greed is the controlling principle in international transactions, and will no doubt continue to be so until the earth has been rendered uninhabitable by reason thereof, it is still just to claim that the more fully the participants in a struggle for territory are mutually informed in reference to its present and future values, the more nearly will a reasonable adjustment of its boundaries to natural conditions be secured.

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## HYDROLOGIC AND HYDROGRAPHIC SURVEYS OF THE UNITED STATES.

As a result of the creation of the new reclamation service under the United States Geological Survey to construct canals, reservoirs, and affiliated works for the irrigation of the public lands of the arid regions of the West, the hydrographic branch of that bureau has been reorganized. As constituted it consists of three principal divisions—namely, hydrography, hydrology, and reclamation surveys, all under the chief engineer, Mr. Frederick Haynes Newell. In bringing about this reorganization the words *hydrography* and *hydrology* have received a special and more limited meaning. Like geography and geology (the latter of which is a special outgrowth of the former, and has to do with the underground geography of the earth's surface), so the name hydrology has been adopted as implying a study of the underground water resources, as distinguished from hydrography, which term is limited to apply to the surface water supplies and sources.

The hydrographic division of the Geological Survey is devoting

its energies to the measurement of the discharge of the various streams of the country, and to a study of the rainfall on the drainage basins of these streams and of their areas, with a view to ascertaining their probable maxima, minima, and average discharge. In the western or arid regions the results of this work will be of immediate use to the engineers having charge of the planning of the Government irrigation works, and in consequence the supervision of the hydrographic work is in most instances vested in the reclamation engineers. In the Eastern States the results of this study are of immediate value to cities seeking additional water supply and to mill owners and others looking for water power. The investigations are accordingly placed under a number of local or resident hydrographers, and are administered from the central office in Washington.

The new division of hydrology has two separate sections. In the western, extensive investigations are being conducted to ascertain the possibilities of developing underground waters for use in irrigation. This investigation includes a careful study of the geologic structure of the regions under examination from which to obtain the basis for prediction of the location and quantity of sub-surface water supplies. Among other purposes, this investigation is expected to indicate where experimental wells, which are provided for under the Reclamation Act, may be sunk. Some sites for such wells have already been selected. Deep wells may be bored for artesian supplies, and galleries or tunnels mined into the water-bearing gravel of the dry streams. In the eastern section similar investigations are being carried on with a view to developing underground water supplies, chiefly for the purpose of domestic and city water supply.

In view of the nature of the investigations to be made, the work has been placed under the immediate supervision and control of geologists; the eastern section under Mr. M. Fuller, and the western under Mr. N. H. Darton.

The eastern section has been divided into about 25 districts, locally managed, in large part, through co-operation with State or college geologists. At present the more important work in hand includes the collection of records of wells, including the amount of water supplied per unit of exposed area for open wells, and for drilled wells, their depth, and the nature of the formations bored. It is expected that the results will throw some light upon the occurrence of underground water, and the possible prediction of its existence in localities in which it is not now known.

In Maine this work is in progress under Prof. W. S. Bayley, of Colby University, chiefly with a view to determining the means of providing water for the summer resort islands. In New Hampshire Mr. Boutwell is conducting examinations with the same purpose in view, as are also Prof. Perkins, State Geologist, in Vermont, Prof. Crosby in Massachusetts and Rhode Island, and Mr. Gregory in Connecticut.

On Long Island more detailed investigations are in progress. These will be very complete, and will include systematic study of the geology and water resources of the entire island. The geologic investigations are under the direction of Mr. Fuller himself, and of Professor Hallock of Columbia University. Under the direction of Mr. Veatch about 1,000 borings will be made in co-operation with the Commission for Additional Water Supply for New York City, and samples of the borings will be recorded for every foot sunk. These will be carefully studied with a view to determining velocity, rate of flow, capillarity, and other physical properties. Professor Slichter of Madison, Wis., who has recently achieved such prominence through the skill which he has displayed in studying the theory and occurrence of underground water supplies, will make measures of the sub-surface flow of water between various wells with the aid of his electrical bridge.

In connection with these investigations the topographic branch of the United States Geological Survey, in co-operation with the State Engineer and Surveyor of New York, has just placed in the field a large force of surveyors under the general direction of Mr. H. M. Wilson, Geographer in charge, who proposes to complete the mapping of the remaining eastern half of Long Island. The resulting work will be published on seven atlas sheets, named: Moriches, River Head, Shelter Island, Sag Harbor, Gardiner Island, East Hampton, and Montauk Point. The force consists of two topographers, several levelmen, and a number of traversemen and field assistants. The whole area to be mapped is approximately 700 square miles, and upon the completion of this survey a small-scale wall map, about 2 miles to 1 inch and with contours of 20 feet interval, will be prepared and published, covering the whole island in one map sheet. This will furnish the basis upon which to complete the investigations of the geology and of the water supply, and will conclude one of the most thorough and systematic studies of the natural resources of a region made in any portion of the United States.

Elsewhere in the east investigations are in progress all along

the Atlantic coastal plain from New Jersey to Texas with a view to developing additional sub-surface sources of water supply. Finally, active field work is in progress in Missouri, Arkansas, Iowa, and Wisconsin. The eastern section of the hydrologic survey has already in preparation co-operative reports of the underground water resources of New Jersey by Mr. Knapp, of Georgia by Assistant State Geologist McCallie, of Alabama by State Geologist E. A. Smith, and of Nebraska by State Geologist Harris.

The western section of hydrology is equally active. In the neighbourhood of Mesa, Arizona, in the Salt River valley, investigations are being conducted by Mr. Lee in co-operation with the engineers of the reclamation service, who plan to add to the sub-surface water supplies. These investigations point to the possibility of increasing the water supply in the region for which water is most precious by the sinking of wells in the deep valley gravels. The efforts to pump some of the existing wells have shown their capacity to be far beyond what had been anticipated, and considerable areas are now under irrigation from steam-pumped wells. In Texas, investigations are in progress with a view to extending the important new artesian water basin recently developed along the coastal plain. In South Dakota, Professor Todd is adding to the information already possessed of the artesian water supplies in the James River valley. In North Dakota, Professor Williard, of the State Agricultural College, is conducting similar work. In Southern California, examination into the underground water supplies, particularly in the neighbourhood of Los Angeles, is being conducted under the direction of Mr. Lippincott, of the reclamation service. In Oregon Mr. Landis, and in Nebraska State Geologist Barber, are directing compilation of data and records of sunk and driven wells.

This section of the hydrologic survey has already in preparation reports of the geology and underground water prospects of the central plains region by N. H. Darton; also special reports on southeastern South Dakota by Professor Todd; on northeastern North Dakota by the late C. M. Hall, and on central New Mexico and Arizona by Mr. Darton.